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Bringing pupils into the ORBYTS of research

The **Twinkle ORBYTS team** discuss their approach to original research with school-aged scientists.

Most scientists would consider themselves lucky to publish a research paper while still an undergraduate, but a group of pupils at Highams Park School in East London has co-authored a paper at age 18, thanks to ORBYTS.

Original Research By Young Twinkle Scientists (ORBYTS) comprises the core part of EduTwinkle, the education and outreach arm of the upcoming exoplanet space mission Twinkle, led by UK scientists and engineers, and is aimed at A-level students.

ORBYTS was founded in 2016 by Clara Sousa-Silva, who was splitting her time teaching at Highams Park School and working as a postdoc at University College London, via the Researchers in Schools programme. This blend of education and research inspired her to set up a scheme enabling young postdoc and PhD students from her research group at UCL, ExoMol, to perform novel research with some of her sixth-form students. ORBYTS now involves more than 30 pupils in eight schools across the UK.

Outreach, inclusivity and diversity are fundamental to ORBYTS: the programme is designed to be accessible to pupils from groups traditionally under-represented in STEM subjects and the space and science communities. Most of the tutors are female, as are the Twinkle mission's lead scientist and lead engineer, something the team is proud of and wishes to build upon.

How ORBYTS works

An early-career scientist, either a PhD student or postdoctoral researcher, is paired with a small group of schoolchildren and typically visits them fortnightly to teach the undergraduate-level physics they'll need to understand the work they'll be doing. If the ORBYTS work is good enough, the pupils will be co-authors on a paper in a peer-reviewed journal, while the scientists gain experience in supervising individuals and leading a research project. Teaching methods evolve as tutors' careers develop. For example, one of the original ORBYTS tutors, Maire Gorman, moved to Aberystwyth University last year and now delivers ORBYTS projects remotely to pupils at St Brendan's College, Bristol, using videos with transcripts, Skype calls and email. Also, both Aberystwyth and UCL have hosted six-week-long summer placements in 2016 and 2017.

ORBYTS projects have focused on molecular spectroscopy, but the range of topics will expand to include, for example, exoplanets and their stellar companions, the origin of life and the engineering side of the Twinkle mission. Specific projects can be tailored to the tutor's interests and research area.



1 ORBYTS in action with (left) Laura McKemmish. (RL Coates)

In one project, pupils were assigned a molecule relevant to exoplanet atmospheres. After locating, collating and forming a lot of experimental spectroscopic data, they used software made by collaborators in Hungary to obtain accurate experimental

energy levels. This is essential research that will help the Twinkle mission to detect these molecules in the atmospheres of exoplanets. In another continuing project, pupils are updating the highly cited 1979 Huber & Herz-

berg database of spectroscopic constants of diatomic molecules by searching the literature to find any experimental results containing updated constants.

Research projects such as these are necessary but time-consuming for academics. ORBYTS demonstrates that school pupils can contribute valuable research information. Pupils not only increase their scientific knowledge, but also gain scientific skills such as literature searching and using advanced Excel; they also gain soft skills such as time management, presentation of complex research findings to general audiences and email communication skills. Participation changes pupils' preconceived notions of what is involved in scientific research and who a scientist is.

Feedback from teachers of the pupils has been positive. "The opportunity to work with young scientists is gold dust to the students and they show their appreciation through their professionalism and dedication to the project," says Jon Barker, physics teacher at Highams Park School. "To have three students as named authors on a published paper from the first year of the ORBYTS programme was a great honour to them as well as the school."

The aim is to expand ORBYTS into more schools and universities, involving and inspiring students in real science. If you would like to be a part of this, please contact orbyts@twinkle-spacemission.co.uk. •

AUTHORS

The ORBYTS tutorial team is **Dr Laura K McKemmish, Katy L Chubb, Tom Rivlin, Jack S Baker and Dr Maire N Gorman**, supported by **Anita Heward, William Dunn, Marcell Tessenyi** and the rest of the **Twinkle team**.

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MORE INFORMATION

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